May 9, 2008

Probability of Turbine Missile Generation

- Applicable Regulations

GDC 4 requires that SSCs important to safety be protected against the effects of missiles that might result from equipment failures. The steam turbine is considered to be a component important to safety because the failure of its massive rotor at a high rotating speed during normal operating conditions of a nuclear unit could generate high-energy missiles that have the potential to damage safety-related SSCs.

- Regulatory Findings

The staff must find after the review and evaluation of the information submitted by the applicant that the probability of turbine missile generation, P_1, is expected to be no greater than $1x10^{-5}$ per reactor year for an unfavorably oriented turbine and no greater than $1x10^{-4}$ for a favorably oriented turbine. This probability represents the general minimum reliability requirement for loading the turbine and bringing the turbine system on line.

- Applicant's Options

Tier 1 information needs to include: (1) Description of turbine orientation - (favorable or unfavorable), (2) State probability value for the identified orientation: $P_1 < 10^{-4}$ for favorable oriented turbine, $P_1 < 10^{-5}$ for unfavorable oriented turbine (unfavorably oriented turbine designs will be reviewed/approved on a case-by-case basis) and (3) include an ITAAC for verification of actual values in COLA's turbine missile probability calculation based upon review of material properties, turbine rotor inspection frequency, turbine valves testing frequency etc.

Tier 2 information needs to include (DCD sections 10.2.3 or 3.5.1.3): Either the DCD applicant submits a bounding turbine missile probability calculation and describes the maintenance and inspection program necessary to maintain the missile generation probability within the bounding values or provides for the following COL Information:

COL applicant item – The COL applicant needs to submit to the NRC for review and approval the turbine missile probability calculation using bounding values if actual values are unknown (3.5.1.3)

COL applicant item – The COL applicant needs to describe maintenance and inspection program related to missile generation [i.e. FSAR level description and no procedures, (10.2.3)]

Tier 2 information in COLAs – When a COLA specifies a different turbine orientation than the one described in the DCD because of pre-existing conditions (e.g., the new turbine cannot be favorably oriented to an existing reactor building in operating plant), the COL applicant needs to: (1) evaluate the effect of turbine missiles from the new turbine on its own reactors systems and components (3.5.1.3), (2) evaluate the effect of external turbine missiles (if any) from any operating plant, and (3) submit for review and approval turbine missile calculation that fully describe maintenance and inspection programs necessary to maintain the missile generation probability within the bounding values. For co-located new and operating plants, the licensee of the operating plant would need to review its own licensing basis for turbine missiles from the new units through existing Part 50 processes.

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